INTERACTION WITH CONSTRAINTS IN THREE-DIMENSIONAL MODELING

by

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N *is created and inserted in the hierarchy between* B *and its supergroup.* N *inherits the constraints of* B, *whereas* B *is made completely constrained relative to* N. A *is made a subgroup of* N, *keeping its constraints.*

This case occurs if an unconstrained group A *is transformed relative to a not completely constrained group of an item* B. *Since the group of an item cannot have subgroups, a new group* N *is created which is rigidly connected with the reference group* B. *The transformed group* A *can now be made a dependent of this new group.*

Figure 6.16 shows an example. A table leg is positioned relative to a table plate, automatically creating a group 'table' to which the plate is completely constrained.

5. *Otherwise, that is if* A *is unconstrained and* B *is completely constrained, let* T *be the topmost mediate supergroup of* B *such that all intermediate groups between* B *and* T *are completely constrained. Then* A *is made a subgroup of* T, *keeping its constraints (they will now be defined relative to* T*).*

This case occurs if an unconstrained group A *is transformed relative to the group of an item* B *that is rigidly connected to an assembly.* T *is the group defining the position, orientation and size of the whole assembly. By making the transformed group* A *a subgroup of* T, *it is made dependent of the assembly.*

Figure 6.17 gives an example. A second leg is added to the table hierarchy

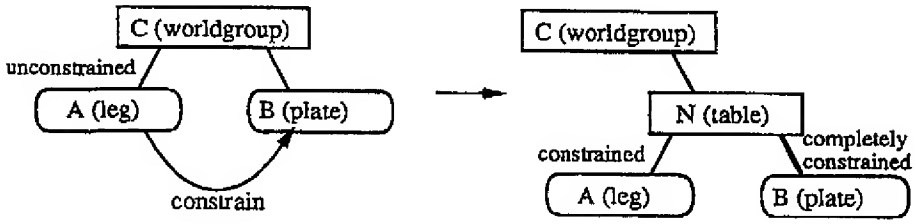

Figure 6.16. Example: Automatic creation of a group when attaching the first leg

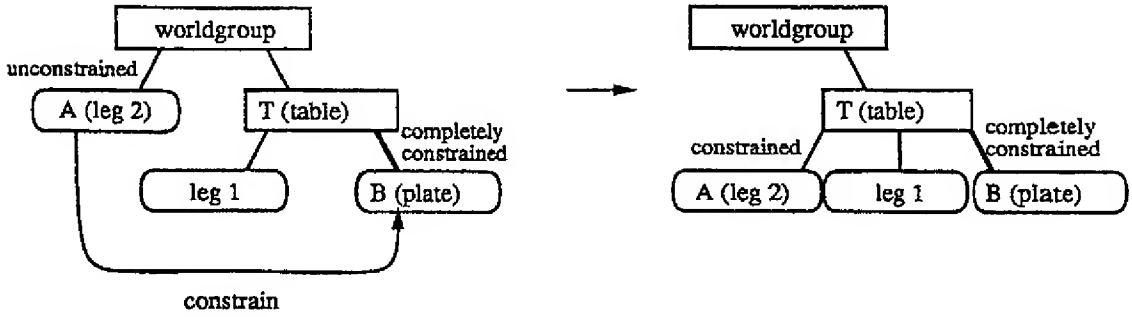

Figure 6.17. Example: No new group is created when attaching the second leg *shown in Figure 6.16.*

The actions resulting from this algorithm turned out to appear logical and straightforward to the user.

6.5 Constructing a Mechanical Device with Constraints

Example 6.3 shows how quickly a robot arm with four degrees of freedom can be assembled using constraints.

Example 6.3 *The robot arm shown in Figure 6.18 is to be constructed. It has one translational degree of freedom in the shoulder (the whole arm can slide along a notch in the base), two rotational degrees of freedom in the elbow, one rotational degrees of freedom in the wrist, one rotational degree of freedom in the hand and two translational degrees of freedom in the moving parts of the clamp that is mounted on the hand.*

First, the parts are constructed by instantiating cubes and cylinders, installing reference points on them, scaling them appropriately and applying transform-to-match operations to assemble the parts which consist of several rigidly connected components (for example the base with the notch). Then the constraints of all parts